

Concurrent Effect of Inspiratory Muscles Training and Kinesio Taping on Inspiratory Muscles Pressure in Athletes

Ahmed Anas Abd Al Raheem*, Nesreen Gharib El Nahas, Emad Mohamed Ibrahim

Physical Therapy Department for Cardiovascular, Respiratory Disorder and Geriatrics, Faculty of Physical Therapy, Cairo University, Egypt

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Abstract: Respiratory muscle training helps to increase respiratory muscle strength and endurance in athletes. Kinesio tape can be used to improve muscular performance. **Aim of the study:** Was to investigate the concurrent effect of inspiratory muscles training and kinesio taping on inspiratory muscles pressure in athletes. **Subjects and Methods:** Sixty male soccer players their ages ranged from 20 to 30 years old. They were recruited from Talae El Geish sporting club, Egypt. The Subjects were randomly assigned into 2 equal groups. They were evaluated by maximum inspiratory pressure (MIP) and cooper test. Group A included 30 subjects received inspiratory muscles training by powerlung device in addition to kinesio tape to the inspiratory muscles (diaphragm). Group B included 30 subjects received inspiratory muscles training by powerlung device only. **Results:** There was significant increase in all values in both groups showed by improvement in MIP by 18.22 %, Cooper test distance by 14.64 % and VO₂ max by 19.64 % in group (A). There was an improvement in MIP by 11.42 %, in Cooper test distance by 10.04 % and VO₂ max by 12.1 % in group (B). **Conclusion:** The results of this study support the importance of concurrent application of inspiratory muscles training and kinesio taping to improve inspiratory muscles pressure in athletes.

Keywords: Inspiratory muscles, Kinesio tape, power lung, athletic performance, muscle strength.

1 Introduction

The respiratory muscle pump is a vital organ that drives alveolar ventilation. The respiratory muscle pump consists of several muscle groups: the diaphragm, which is the main muscle for inspiration; the accessory inspiratory muscles, including the parasternal, external intercostal, scalene, and sternocleidomastoid muscles. While the expiratory muscles include the lateral abdominal wall muscles, the internal intercostal muscles, and transverse thoracic muscle [1].

Cardiovascular fitness is one of the most important aspects of physical fitness in soccer, in this context, well-developed aerobic fitness helps soccer players to maintain repetitive high-intensity actions within a soccer match, to accelerate the recovery process, and to maintain their physical condition at an optimum level during the entire game and season [2-3].

Two theories postulated to explain better sport performance from respiratory muscles training (RMT) are reduced ratings of perceived breathlessness (RPB) or effort (RPE) and attenuation of the metaboreflex phenomenon,

which may result in the diversion of blood flow from locomotor muscles to respiratory muscles [4].

Respiratory muscle training has been documented to improve performance in a wide range of exercise modalities including running, cycling, swimming, and rowing. The physiological effects of RMT that may explain the improvements in performance have been proposed to include diaphragm hypertrophy, muscle fiber-type switching, improved neural control of the respiratory muscles, increased respiratory muscle economy, attenuation of the respiratory muscle metaboreflex, and decreases in perceived breathlessness and exertion. [5].

Kinesiology taping is a technique that was developed by Dr. Kenzo Kase in 1973 The tape material used in kinesiology taping is of epidermis thickness and weight and has a structure providing elasticity up to 55–60% of its normal size. It allows evaporation and can dry on the skin easily due to it being 100% cotton fiber material knitted with pin-holes.

Kinesio Tape (KT) is an elastic tape which was known for its therapeutic effects. It was developed in Japan in 1973 by a kinesiologist Kenzo Kase to help with the functionality of the body and its natural healing process. The makers of the tape were experimented with different types of tapes and taping techniques and developed the

*Corresponding author E-mail: Ahmedanas16790@gmail.com

material. Step by step Kase gradually improved the different techniques based on his professional experience. It was later introduced into United States in the 1995 and the technique gained more popularity when it was used on athletes during the Beijing Olympics in 2008 [6].

The structure of the tape and the application technique results in the therapeutic effects of Kinesio tape. These effects include improving circulation of the blood and lymph, decreasing pain, stimulating proprioception, stabilizing articulars and restoring muscle tone [7-10].

The effect of Kinesio taping on muscular strength depends on the application technique. Taping from the insertion of muscle to its origin inhibits muscle function, whereas taping from the muscle origin to insertion facilitates the muscle function [11].

The diaphragm, which is a primary respiratory muscle, acts as a piston. It lowers pleural pressure and inflates the lungs by moving in the caudal direction with the ribs [12].

Respiratory muscle function is essential for life. Respiratory muscles. Like all skeletal muscles, improve their function in response to training. Unlike limb muscles, however, they must contract repetitively, approximately 12 to 20 times per minute every day of our lives. Because the inspiratory muscles are used so frequently, they have no opportunity to rest and may become fatigued or injured under conditions that overload the respiratory system. [13].

Our aim was to investigate the concurrent effect of inspiratory muscles training and kinesio taping on inspiratory muscles pressure in athletes to minimize respiratory fatigue and improve respiratory muscle performance, as IMT are related to increased strength and resistance of the respiratory musculature, as they can enhance sport performance in athletes, and also KT have the effect of increasing muscular strength and facilitating the muscle function [7-14].

2 Subjects and Methods

This was a randomized controlled study that was carried on Sixty male soccer players, their ages ranged from 20 to 30 years old, they were within normal average of body mass index (18:25kg/m²) and their waist circumference was < 94 cm. The subjects were recruited from Talae El Geish sporting club Egypt. During the period between September 2020 and March 2021. They were randomly assigned into 2 groups equal in number, Group (A) included 30 subjects in which Kinesio tape was applied to the inspiratory muscles (diaphragm) in addition to inspiratory muscles training by powerlung device for six weeks. Group (B) included 30 subjects which had inspiratory muscles training by powerlung device only for six weeks.

The exclusion criteria were smoking, exercise induced asthma, acute or chronic infection to the respiratory system, any skin sensitivity, any previous chest surgery as Lobectomy.

Instruments:

I) Evaluation Instruments :(done twice at beginning and after 6 weeks of training)

- Recording data sheet: All data and information of each patient in this study including name, age, height, weight and BMI were recorded in a recording sheet.
- Respiratory Pressure Gauge with maximum effort indicator is the preferred and recommended one-way valve setup for measuring either inspiratory or expiratory pressure it consists of a T-piece with 22 mm ends to which one-way valves are attached. Depending on which valve is closed off (capped), it measures either inspiratory or expiratory pressure. An 18 inch (45 cm) long flexible tube is attached to the center of the "T" the other end is attached to the gauge [15].
- Cooper test on 400-m athletic track to estimate maximal oxygen consumption.

II- Therapeutic Instruments

- Inspiratory muscle trainer by power lung device (Sport Active Series Dark Blue Model, US).
- Kinesio tape

A) Procedures:

I- Evaluation Procedure

Maximum inspiratory muscles pressure was measured during forced inspiration following expiration. The measurements were repeated 3 times and the highest value was recorded.

Cooper test: maximum possible distance covered for 12 min. Before the test began, a 15-min warm-up of continuous running was performed at a low-moderate pace in addition to calisthenics exercises.

2-Therapeutic Procedure

- **Inspiratory muscle training (for both groups):** Each session was composed of 3 sets of 10 repetitions, each set took approximately 2 min duration, there was 2 min rest involving normal quiet breathing between sets. Subject breathe in through power lung device for 3 seconds (make abdomen like a balloon), pause for 2 seconds, breathe out through the nose for 3 seconds (3 times per week, 10 to 15 minutes for each session for six weeks, resistance increased every week) [16].
- **Kinesiotape: (for group A only)** The application Procedures were done for a period of six weeks. Kinesio tape was applied every 4 days. The Kinesio tape was applied to the primary inspiratory muscles (diaphragm) of the subjects. Two tapings were applied to the

diaphragm, from the abdomen and back. **Starting position from the abdomen:** The participant was standing with his trunk in hyperextension and both arms overhead. The base point of the tape was applied on the xiphoid process without tension and the tails of the tape were applied towards the ribs with approximately 25% tension. **Starting position from the back:** The participant was standing. The projection of the xiphoid process on the back was determined as the

for all statistical tests was set at $p < 0.05$. Statistical analysis was performed through the statistical package for social studies (SPSS) version 25 for windows. (IBM SPSS, Chicago, IL, USA).

3 Results and Discussion

In the current study, a total of 60 subjects participated and they were randomly assigned into 2 groups (30 subjects/group). There was no significant difference in demographic data between group A and group B in age, BMI and WC ($p > 0.05$). (Table 1).

Table 1: Demographic data of subject characteristics between group A and B:

	Mean \pm SD		MD	t- value	p- value
	Study group	Control group			
Age (years)	22.03 \pm 1.18	21.67 \pm 1.09	0.36	1.24	0.21
BMI (kg/m ²)	21.92 \pm 0.67	22.07 \pm 0.63	-0.15	-0.95	0.34
WC (cm)	77.93 \pm 2.21	78.13 \pm 1.85	-0.2	-0.38	0.71

SD, Standard deviation; MD, Mean difference; p-value, level of significance; BMI, Body mass index; WC, waist circumference.

There was a significant increase in MIP, Cooper test distance and VO₂ max of group (A) compared with that of group (B) post training program.

- Within group comparison

There was a significant increase in in MIP, cooper test distance and VO₂ max of group A and B post training compared with that pre-training ($p < 0.001$). The percent of change of MIP, Cooper test distance and VO₂ max of group A was 18.22, 14.64 and 19.64% respectively and that of group B was 11.42, 10.04 and 12.1% respectively. (Table 2).

- Between groups comparison:

There was no significant difference between groups pre-training ($p > 0.05$). There was a significant increase in MIP, Cooper test distance and VO₂ max of group A compared with that of group B post training ($p < 0.001$). (Table 2)

This study was conducted to investigate the concurrent effect of inspiratory muscles training and

towards the ribs with approximately 25% tension.

Statistical analysis:

Unpaired t-test was conducted for comparison of subject characteristics between groups. Normal distribution of data was checked using the Shapiro-Wilk test. Levine's test for homogeneity of variances was conducted to ensure the homogeneity between groups. Mixed MANOVA was conducted to compare the effect of time and the effect of training as well as the interaction between time and training on MIP, Cooper test distance and VO₂ max. post-hoc tests using the Bonferroni correction were carried out for subsequent multiple comparison. The level of significance

kinesio taping on inspiratory muscles pressure in athletes., their ages ranged from 20 to 30 years old. They were assigned into two equal groups. **Group A** included 30 subjects, The Kinesio tape was applied to the inspiratory muscles (diaphragm) of the subjects in addition to inspiratory muscles training by powerlung device (The kinesio tape sessions were done every 4 days, the power lung device resistance increased every week for a total study program of six weeks). **Group B** included 30 subjects which had inspiratory muscles training by powerlung device only.

The values of maximum inspiratory muscles pressure and cooper test were recorded before and after the study program.

A number of studies have evaluated the acute effect of kinesiology taping. Kenzo Kase claimed that the effect of kinesiology taping lasts for 3–4 days [6].

Barnes et al., found that training the respiratory muscles with power lung device increased the strength of the respiratory muscles, and also these increase in respiratory strength led to an increase in VO₂max and total performance time during the treadmill test [17].

The results of this research agreed with a study done by Minsoo et al., conducted on healthy males who performed inspiratory muscle training (IMT) and Kinesio tape was applied on diaphragm, scalene, sternocleidomastoid and pectoralis minor. The inspiratory pulmonary muscle strength was measured by maximal inspiratory pressure (PI max) which concluded that inspiratory muscle training and Kinesio tape maximize inspiratory muscles strength [18].

Lewis., disagreed with our study, who reported that respiratory muscles strength training (RMST) with power

lung trainer for five weeks did not appear significant improvement on individuals with Parkinson's disease [19].

In addition, Williams et al., meta-analysis came parallel with our study found that 7 out of 10 investigated studies showed that KT had some substantial effects on muscle activity, for quadriceps and hamstrings peak torque, and grip strength measures, concluded that KT may have a small beneficial role in improving strength [20].

Regarding to lumbroso et al., the application of Kinesio tape on muscles has been shown to exert an immediate effect on muscular strength [23].

Respiratory muscles, including the diaphragm, are closely associated to the skeleton and share functional characteristics with limb muscles, they should respond to training in the same way that limb muscles do when the right body structure-related load is applied [24].

Table 2: Mean MIP, cooper test distance and VO2 max pre and post training of group A and B:

	Group A Mean \pm SD	Group B Mean \pm SD	MD (95% CI)	p- value
MIP (cm H2O)				
Pre-training	94.23 \pm 4.08	95.61 \pm 4.55	-1.38 (-3.6: 0.86)	0.22
Post training	111.4 \pm 4.64	106.53 \pm 5.43	4.87 (2.25: 7.47)	0.001
MD (95% CI)	-17.17 (-18.17: -16.16)	-10.92 (-11.93: -9.93)		
% Of change	18.22	11.42		
	p = 0.001	p = 0.001		
Cooper test distance (meters)				
Pre-training	2951.33 \pm 146.37	2929.33 \pm 190.15	22 (-65.7: 109.7)	0.61
Post training	3383.5 \pm 162.83	3223.5 \pm 204.42	160 (64.48: 255.51)	0.001
MD (95% CI)	-432.17 (-450.52: -413.82)	-294.17 (-312.51: -275.81)		
% Of change	14.64	10.04		
	p = 0.001	p = 0.001		
VO2 max (ml/kg/min)				
Pre-training	54.68 \pm 3.27	54.21 \pm 4.25	0.47 (-1.48: 2.43)	0.62
Post training	65.42 \pm 3.69	60.77 \pm 4.56	4.65 (2.49: 6.79)	0.001
MD (95% CI)	-10.74 (-11.73: -9.74)	-6.56 (-7.56: -5.57)		
% Of change	19.64	12.1		
	p = 0.001	p = 0.001		

A study of healthy participants investigating KT application on the biceps brachii concentric elbow peak torque significantly increased even when compared to placebo taping [21].

On the other hand, another meta-analysis studies, investigated the efficacy of Kinesio taping in facilitating contraction and increasing muscle strength in healthy adults, the usage of KT to facilitate muscular contraction has no or only negligible effects on muscle strength [22].

4 Conclusions

The encouraging results of this study showed that the concurrent application of inspiratory muscles training and kinesio taping improve inspiratory muscles pressure in athletes.

Conflict of interest

The authors confirm that this article content has no conflict of interest.

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